

**Annotated Vascular Plant Database  
Grand Canyon Parashant National Monument  
Phase 1 Report**

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## INTRODUCTION

Grand Canyon-Parashant National Monument (PARA) is located in northwestern Arizona between the north rim of the Grand Canyon and the Utah and Nevada borders. The boundary of the monument extends from Black Rock Mountain south to the Lake Mead and the north border of Grand Canyon National Park and from the Arizona/Nevada state line to Poverty Mountain, Mount Trumbull, and Toroweap Valley. Established by presidential proclamation in January 2000, PARA contains over one million acres of public lands managed jointly by the Bureau of Land Management and National Park Service.

Beginning with the pioneering work of Edward Palmer, Charles Parry, and Marcus E. Jones in the 1870s and 1880s, the Grand Canyon-Parashant area has attracted the attention of numerous botanists (Cronquist et al. 1972, Welsh and Atwood 2009). The flora of the region is unusually species-rich due to the convergence of three major floristic regions: the Great Basin, Mojave Desert, and Colorado Plateau (McLaughlin 2007). Several recent floristic studies have been conducted in the Parashant area and adjacent Arizona Strip to document this diversity, including works by Atwood et al. (2000, 2002, 2003, 2005), Powell (2002), Shultz and Kelly (2006), and Bangle (2007).

In 1998, Congress passed the National Parks Omnibus Management Act to provide guidance and funding for baseline inventory and monitoring work in NPS units across the country. Knowing the status of a park's flora and fauna is critical for effective management and systematically identifying gaps in the nation's protected area network (Margules and Pressey 2000). The NPSpecies database was developed to help manage information on the status of plant and animal species in park units. Populating this database has been a challenge for many parks where plant records and specimens are dispersed among multiple herbaria and numerous published and unpublished references, or surveys are incomplete.

In 2009, Grand Canyon-Parashant National Monument entered into a cooperative agreement with Southern Utah University to revise PARA's NPSpecies database through a comprehensive review of recent literature, websites, and herbarium collections housed at PARA, the BLM Arizona Strip Field Office (ASD), Northern Arizona University (ASC\*), and Brigham Young University (BRY). The following report outlines the methods used to generate the revised NPSpecies database, briefly summarizes the area's floristic diversity, and discusses areas in need of additional field studies.

\*Herbarium acronyms are based on the New York Botanical Garden's Index Herbariorum website ([sciweb.nybg.org/science2/IndexHerbariorum.asp](http://sciweb.nybg.org/science2/IndexHerbariorum.asp)). ASC stands for Arizona State College, the original name of Northern Arizona University.

## METHODS

In the fall of 2009 I assembled a preliminary checklist of the flora of PARA in MS Excel format based on a review of pertinent literature (Anonymous 2003; Atwood et al. 2000, 2002, 2003, 2005; Bangle 2007; Boufford 1992; Chamberland 1995; Christy 1998; Haber 1992; Hodgson 1999; Mason 1998; Pinkava 1999; Powell 2002; Shultz and Kelly 2006; Wilken and Porter 2005) and electronic specimen databases (New York Botanical Garden Virtual Herbarium website at <http://sciweb.nybg.org/science2/hcol/intf/index.asp> and Southwest Environmental Information Network at <http://swbiodiversity.org/seinet/collections/index.php>). Additional species were added through a review of mounted and unmounted herbarium specimens housed at Grand Canyon-Parashant National Monument, the BLM Arizona Strip Field Office (ASD), Brigham Young University (BRY), and Northern Arizona University (ASC). Annotations were made to these collections if they were misidentified. Nomenclature primarily followed the USDA PLANTS database (<http://plants.usda.gov/>) except for newly described taxa (Atwood 2007, Atwood and Welsh 2007, Welsh et al. 2008).

The draft species checklist was subdivided into five lists:

1. Vascular plant species confirmed as present in Grand Canyon-Parashant National Monument based on my examination of at least one authenticated herbarium specimen placing the species within PARA boundaries. This list included species found prior to 1970 (considered historical) and those confirmed since.
2. Vascular plant species reported for the monument in the literature but not corroborated by a voucher specimen (equivalent to "probably present" in NPSpecies terminology).
3. Potential species ("unconfirmed" in NPSpecies terminology) known from the vicinity of the monument based on authenticated herbarium specimens or reliable literature reports, but not yet recorded from PARA. Species were excluded from this list if suitable habitat was not present within the monument.
4. Falsely reported species that are now known to be misidentified (based on examination of critical herbarium material) or highly questionable (known from unconfirmed literature reports but not known or expected from northern Arizona or the PARA area).
5. Master checklist combining the four preceding lists.

Each list was annotated with supplemental information on life form, distribution within Arizona and PARA, abundance in the monument, flowering period, year first documented, habitat, and other pertinent comments (summarized in Table 1). Synonyms and a discussion of taxonomic problems were also included based on a literature review (Barkworth et al. 2003, 2007; Barneby 1989; Cronquist 1994; Cronquist et al. 1972, 1977, 1984, 1997; Flora of North America Editorial Committee

**Table 1.** Data Fields in the Annotated Checklist of the Flora of Grand Canyon-Parashant National Monument (see “PARA Master Plant List August 2010 excel worksheet”).

Field	Description	Data Sources
Family	Primary taxonomic family. Synonymous family names are included in parentheses. Segregate families are listed in the Notes column.	USDA PLANTS Database and literature review
Species Name	Accepted taxonomic name, following the USDA Plants Database standard.	USDA PLANTS Database
Synonym	Other names used for the species in contemporary regional and state floras and taxonomic treatments.	Literature review
Common Name	Primary accepted common name	USDA PLANTS Database
USDA PLANTS Code	Standardized acronym for the scientific name of each species, based on the first two letters of the genus, specific epithet, and variety or subspecies, followed by a tiebreaker number if necessary. Recently described species without an official code are indicated by “x” as the tiebreaker.	USDA PLANTS Database
GRank	Global abundance and conservation priority rank, as designated by NatureServe. Full species (G) and infraspecific taxa (T) are ranked on a scale of 1-5, with 1 being extremely vulnerable and 5 being secure. “?” indicates uncertainty in the rank, Q = taxonomic questions, U = unknown, and NR = not rated.	NatureServe website ( <a href="http://www.natureserve.org">www.natureserve.org</a> )
AZ Dist	Arizona distribution is defined as the state’s contribution to a species’ overall range. One of the following 7 categories is used: <b>Disj</b> (Disjunct) taxa have their Arizona distribution separated from the main, contiguous portion of their range by a gap of at least 800 km; <b>Intro</b> (Introduced) taxa are not native to Arizona but have become naturalized (breeding on their own without human interference); <b>LocEn</b> (Local Endemic) taxa with their entire global range restricted to an area of less than 16,500 km <sup>2</sup> or approximately 1° of latitude x 2° of longitude; <b>Periph</b> (Peripheral) taxa have a widespread global distribution but are found at the edge of their contiguous range in Arizona (occupying less than 5% of the state and restricted to the border region); <b>RegEn</b> (Regional Endemic) taxa with a global range of 16,500-250,000 km <sup>2</sup> (about equal to the area of the state of Wyoming); <b>Sparse</b> taxa occur widely across Arizona and the US but have widely scattered and small occurrences in the state and are limited to specialized or uncommon habitats; <b>Wide</b> (Widespread) taxa have global ranges greater than 250,000 km <sup>2</sup> and occur over more than 5% of the state.	Literature review

Table 1 continued		
Field	Description	Data Sources
Form	Growth form is based on the stature and habit of typical members of a species at reproductive maturity. <b>AnnF</b> (Annual Forbs) are broad-leaved dicots or monocots with non-woody stems that complete their life cycle (mature, flower, die) in one year; <b>AnnG</b> (Annual Graminoids) are linear-leaved, grass-like monocots that complete their life cycle in one year; <b>Ferns</b> and fern-allies are non-flowering vascular plants that reproduce by spores; <b>PerF</b> (Perennial Forbs) are broad-leaved dicots or monocots with non-woody stems (at least above-ground) that live for multiple years; <b>PerG</b> (Perennial Graminoids) are linear-leaved, grass-like monocots that live for multiple years; <b>Shrubs</b> are woody perennials with one to many main stems and are usually less than 3.5 m tall; <b>Trees</b> are woody perennials with a single stem and are typically over 3.5 m tall.	Literature review
PARA Status	Status within Grand Canyon-Parashant NM (PARA) based on the following categories: <b>Present</b> (documented by a voucher collected since 1970); <b>Historical</b> (documented by a voucher but not relocated since before 1970); <b>Reported</b> (plausibly listed for PARA in the literature but not vouchered); <b>Potential</b> (known from the vicinity of PARA and likely to occur but not confirmed yet); <b>False Report</b> (previous reports for PARA are based on misidentified specimens or improbable literature reports)	Herbarium and literature review
BLM Portion	Species known from BLM lands within PARA are indicated by an "x"; those suspected to occur are indicated by "?"	Herbarium and literature review
NPS Portion	Species known from NPS lands within PARA are indicated by an "x"; those suspected to occur are indicated by "?"	Herbarium and literature review
Yr First Doc	Year when the species was first documented in PARA. This year does not necessarily correspond to the collection cited under documentation. "NA" indicates that the year is not known (used only for some reported taxa)	Herbarium and literature review
Documentation	For Present and Historical species, documentation consists of a verified herbarium specimen (including the collector, collection number, and repository). For reported species, documentation is the literature source that places the species within PARA	Herbarium and literature review
Notes	Additional information on legal status, region of origin for introduced species, type locality data (only given if the type is from the general vicinity of PARA), comments on taxonomic problems, alternative family treatments, or other notes pertinent to the status of a species in PARA.	Herbarium and literature review, Spears (2006)

Table 1 continued		
Field	Description	Data Sources
Abundance	Abundance of a species within PARA is based on the following categories: <b>Com</b> (Common) taxa have large populations, are dominant on the landscape, or occur extensively across PARA; <b>Unc</b> (Uncommon) taxa have low to medium-sized populations, contribute little cover, or have a small range across PARA; <b>Rare</b> taxa have low population numbers and are restricted to 1-2 sites in PARA; <b>NA</b> indicates abundance is not known.	Herbarium and literature review
Flowering Period	Months when a species is flowering (not applicable to non-flowering ferns and gymnosperms)	Literature review
Habitat	General habitat types in which a species is known or suspected to occur within PARA	Literature review
Wet	Wetland or riparian habitats	Literature review
Mojv Des Scrub	Mojave Desert Scrub dominated by warm desert shrub species, including Creosote bush, Joshua tree, Blackbrush, Cholla, and Burro-brush.	Literature review
Salt Shrub	Salt Desert Shrub, dominated by Shadscale (or other members of the Chenopodiaceae) and other salt-tolerant shrubs, grasses, and forbs.	Literature review
Grt Basin	Great Basin desert shrub and grasslands dominated by Big sagebrush	Literature review
Pinyon-juniper	Pinyon-juniper woodlands dominated by Singleleaf or Two-needle pinyon and Utah juniper	Literature review
Mtn Brush	Mountain brush communities dominated by Gambel oak, maple, manzanita, and other shrubs of intermediate to high elevation	Literature review
Pndrsa For	Ponderosa pine forests at higher elevations	Literature review
Rock	Bare rock outcrops	Literature review
Dist	Disturbed areas	Literature review
Other Comments	Additional comments on specific soil types or geologic substrates	Literature review

1993, 1997, 2000, 2002a, 2002b, 2003, 2005, 2006a, 2006b, 2006c, 2009, 2010; Holmgren et al. 2005; Kearney and Peebles 1960; McDougall 1973; Welsh et al. 2008), including relevant issues of the *Journal of the Arizona-Nevada Academy of Science* and *Canotia*.

## RESULTS

Based on examination of over 3000 herbarium specimens and review of recent literature, the vascular plant flora of Grand Canyon-Parashant National Monument consists of 1016 taxa\* (Table 2). Of these, 966 taxa have been confirmed with

\*Taxa refer to all named species, subspecies, and varieties. In deriving the total number of taxa, each full species is counted once. Varieties or subspecies contribute to the total number of taxa only when two or more known from PARA. For example, the species *Artemisia tridentata* has two subspecies present in the monument (ssp. *tridentata* and *vaseyana*) and these count as two separate taxa, whereas *Artemisia campestris* has a single variety (var. *scouleriana*), and is counted once.

authenticated herbarium vouchers and another 50 are known only from literature reports. Excluding varieties and subspecies, 968 species from 93 families are known or reported from the monument.

Nearly 300 additional vascular plant species have been reported from adjacent areas of the Arizona Strip and Washington County, Utah (Atwood et al. 2000, 2003; Welsh et al. 2008). At least 193 of these species are known from the Virgin River Gorge, Virgin Mountains, Black Rock, Toroweap, Lake Mead NRA, Main Street Valley, and Colorado City area and are included in the draft checklist as “potential” species. Another 82 taxa found only in the vicinity of Fredonia, AZ, or on the Kaibab and Paria plateaus east of the monument have been excluded. Most of the excluded taxa occur in specialized soil or vegetation types that are poorly represented or absent from PARA.

At least 48 additional plant taxa previously reported for Grand Canyon-Parashant National Monument are now considered false reports based on misidentified specimens in the PARA and BRY herbaria or on erroneous reports in the literature. Some of the

**Table 2.** Statistical Summary of the Flora of Grand Canyon-Parashant National Monument. Categories are fully defined in Table 1.

<b>Flora of Grand Canyon-Parashant NM</b>	<b>Present and Historic in Park</b>	<b>Reported for Park</b>	<b>Total</b>
<b>Taxonomic Diversity</b>			
Total Taxa (including varieties & subspecies)	966	50	1016
Taxonomic Species (excluding varieties & subspecies)	923	45	968
Families	92	1	93
<b>Life Form Diversity</b>			
Trees	18	2	20
Shrubs	156	7	163
Perennial Forbs	378	20	398
Annual Forbs	284	17	301
Perennial Graminoids	84	4	88
Annual Graminoids	35	0	35
Ferns & Fern Allies	11	0	11
<b>Biogeographic Diversity</b>			
Introduced	88	4	92
Native (Total)	878	46	924
Locally Endemic	15	1	16
Regionally Endemic	110	8	118
Disjunct	0	0	0
Peripheral	48	5	53
Sparse	1	1	2
Widespread	704	31	735

falsely reported species may occur in the monument, but were not included in the potential list to avoid confusion. Additional species currently on the monument's reported list ultimately may be re-classified as falsely reported once critical specimens are relocated.

The confirmed and reported flora of PARA represents 24% of the 4,241 native and naturalized vascular plant taxa documented for Arizona by Kartesz (2003). Within Mohave County, the monument flora captures 64% of the 1,588 reported plant taxa (Kartesz 2003). Grand Canyon-Parashant National Monument contains 40% of the 2517 species of seed plants and ferns cited for the Arizona Strip by Atwood et al. (2003), McDougall (1973) and Flora of North America Editorial Committee (1993).

Perennial forbs contribute the greatest number of species to the flora of PARA with 398 documented or reported taxa (Table 2) or 39% of all species. The percentage of annual forbs is also high (301 taxa or about 30% of the total flora). While ecologically dominant, shrubs contribute just 16% of all plant species and perennial grasses and grass-like plants (graminoids) represent only 8.7% of all taxa. Just 2% of known species are trees and only 1% are ferns.

At least 92 introduced plant taxa have been recorded at PARA, or 9.1% of the entire flora. This figure is lower than the statewide average of 12.7% non-native species recorded by Kartesz (2003). Fourteen plant species from the monument are listed as noxious weeds by the state of Arizona (ADAPSD 2005), including three weedy natives (Table 3). Twelve noxious species are on the state's prohibited list, while nine are restricted and four regulated (ADAPSD 2005).

Of the 924 native taxa, 79.5% occur widely across Arizona and western North America. Approximately 14.5% are local or regional endemics restricted to the Parashant area or the Mohave and Colorado Plateau ecoregions. Less than 6% of the native species occur at the periphery of their range in Arizona or sparsely across the state (Table 3).

No plant species from PARA are presently listed as threatened or endangered under the US Endangered Species Act, though two endangered plants (*Astragalus cremnophylax* var. *cremnophylax* and *A. holmgreniorum*) are known from the vicinity. Gierisch's globemallow (*Sphaeralcea gierischii*) is the only species from PARA currently considered an official candidate for potential listing (Table 4). At least six species from the monument are classified as sensitive by the Bureau of Land Management or US Forest Service (Table 4). Several recently described narrow endemics from PARA and vicinity (such as *Lesquerella arizonica* var. *andrusensis*, *Camissonia dominguez-escalantorum*, *Eriogonum umbellatum* var. *mohavense*, *Phacelia furnissi*, *P. higginsii*, and *P. hughesii*) might warrant sensitive or candidate status in the future (Atwood 2007, Atwood and Welsh 2007, Flora of North America Editorial Committee 2005). Presently nine species (mostly commercially valuable cacti and yuccas) are classified as "salvage restricted" in Arizona, meaning that their collection is prohibited without a permit (AGFD 2009).

**Table 3.** Noxious Weed Species of Grand Canyon-Parashant National Monument.

<b>Family</b>	<b>Species</b>	<b>Common Name</b>	<b>AZ Noxious Weed Status</b>
Asteraceae	<i>Acroptilon repens</i>	Russian knapweed	Prohibited Noxious Weed, Restricted Noxious Weed
Asteraceae	<i>Helianthus ciliaris</i>	Blueweed sunflower	Prohibited Noxious Weed, Restricted Noxious Weed
Asteraceae	<i>Onopordum acanthium</i>	Scotch thistle	Prohibited Noxious Weed, Restricted Noxious Weed
Brassicaceae	<i>Cardaria draba</i>	Whitetop	Prohibited Noxious Weed, Restricted Noxious Weed
Convolvulaceae	<i>Convolvulus arvensis</i>	Field bindweed	Prohibited Noxious Weed, Regulated Noxious Weed
Convolvulaceae	<i>Ipomoea costellata</i> *	Crest-rib morning-glory	Prohibited Noxious Weed
Cuscutaceae**	<i>Cuscuta californica</i> *	Chapparal dodder	Prohibited Noxious Weed, Restricted Noxious Weed
Cuscutaceae**	<i>Cuscuta pentagona</i>	Field dodder	Prohibited Noxious Weed, Restricted Noxious Weed
Fabaceae	<i>Alhagi maurorum</i>	Camelthorn	Restricted Noxious Weed
Fabaceae	<i>Medicago polymorpha</i>	Bur clover	Prohibited Noxious Weed, Regulated Noxious Weed
Poaceae	<i>Aegilops cylindrica</i>	Jointed goatgrass	Prohibited Noxious Weed, Restricted Noxious Weed
Poaceae	<i>Elymus repens</i>	Creeping wildrye	Restricted Noxious Weed
Portulacaceae	<i>Portulaca oleracea</i>	Common purslane	Prohibited Noxious Weed, Regulated Noxious Weed
Zygophyllaceae	<i>Tribulus terrestris</i>	Puncture vine	Prohibited Noxious Weed, Regulated Noxious Weed

\*Native species

\*\*All *Cuscuta* species are listed as “noxious”

**Table 4.** Rare and Salvage Restricted Plant Species of Grand Canyon-Parashant National Monument. All are confirmed as present in PARA except *Psoralea argophylla* var. *pubescens* (reported). Derived from AGFD (2009).

Family	Species	Common Name	TNC Rank	Federal Status	AZ Status
Agavaceae	<i>Hesperoyucca whipplei</i>	Our Lord's-candle	G4G5/S3S4		Salvage restricted
Asteraceae	<i>Enceliopsis argophylla</i>	Silverleaf enceliopsis	G2G3/S2	BLM Sensitive	
Asteraceae	<i>Townsendia smithii</i>	Black Rock townsendia	G1/S1	BLM Sensitive	
Cactaceae	<i>Cylindropuntia echinocarpa</i>	Pale cholla	G3G4Q/S5		Salvage restricted
Cactaceae	<i>Cylindropuntia whipplei</i> var. <i>whipplei</i>	Whipple's cholla	G4?/S1		Salvage restricted
Cactaceae	<i>Echinocactus polycephalus</i> var. <i>polycephalus</i>	Manyhead barrel cactus	G3G4 T3/S2		Salvage restricted
Cactaceae	<i>Echinocactus polycephalus</i> var. <i>xeranthemoides</i>	Kaibab barrel cactus	G3G4 T1/S2S3		Salvage restricted
Cactaceae	<i>Escobaria vivipara</i> var. <i>rosea</i>	Rosy pincushion cactus	G5 TNR/S3		Salvage restricted
Caryophyllaceae	<i>Arenaria aberrans</i>	Mount Dellenbaugh sandwort	G2/S2	USFS Sensitive	
Fabaceae	<i>Psoralea argophylla</i> var. <i>pubescens</i>	Mojave dalea	G5T2/S2	BLM Sensitive	
Malvaceae	<i>Sphaeralcea gierischii</i>	Gierisch's globemallow	G1/S1	USFWS: Candidate	
Onagraceae	<i>Camissonia exilis</i>	Meager camissonia	G1/S1		Salvage restricted
Rosaceae	<i>Rosa stellata</i> var. <i>abyssa</i>	Desert rose	G4T2/S2	BLM Sensitive, USFS Sensitive	Salvage restricted
Scrophulariaceae	<i>Penstemon distans</i>	Mount Trumbull penstemon	G2/S2	BLM Sensitive, USFS Sensitive	Salvage restricted

## DISCUSSION

With 1016 documented and reported plant taxa in its flora, Grand Canyon-Parashant National Monument ranks third among protected areas of the Arizona Strip, adjacent southern Utah, and southern Nevada in total plant species richness. Grand Canyon National Park has the largest flora, with nearly 1700 species reported (Ayers et al. 1994; Brian et al. 2000; Grand Canyon National Park 2005, Phillips et al. 1987). Utah's Zion National Park recently moved into second place, with 1023 taxa confirmed or reported (Fertig and Alexander 2009, Fertig et al. 2010). Grand Canyon-Parashant leads Grand Staircase-Escalante National Monument's 999 taxa (Fertig 2005, 2009), Lake Mead National Recreation Area's 1009 taxa (Bangle 2007), Glen Canyon National Recreation Area's 889 species (Hill 2005, Spence 2005), and Pipe Spring National Monument's 313 species (Fertig and Alexander 2008, Fertig 2008)\*. With nearly 40% of the known flora of the Arizona Strip present, PARA plays an important role in the long-term conservation of native botanical diversity in the region.

The number of plant species known from PARA will likely increase with additional surveys that target specific taxa and geographic areas. A large number of plants from the potential species list occur in Lime Kiln Canyon and the Black Rock area of the Virgin Mountains just outside the monument boundary. Many of these taxa were collected prior to the establishment of PARA and follow-up surveys might locate these species in suitable habitats within the monument. Similar clusters of potential species are also found in the Toroweap area of Grand Canyon National Park, along Grand Wash Bay in Lake Mead NRA, and in the Main Street Valley and Mount Trumbull School areas on lands managed by the BLM Arizona Strip Field Office near the PARA boundary. Additional investigation of herbarium collections at Lake Mead NRA, University of Nevada Las Vegas, Northern Arizona University, University of Arizona, and Arizona State University could also reveal new plant species for PARA.

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\*Data not included for Vermilion Cliffs National Monument

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